Diabetic patients can pose some unique challenges in the peri-anesthetic period. Pre-operative 12 hour or 24 hour blood glucose curves should be current and the insulin dose adjusted appropriately for the patient to be as stable as possible.

Pre-operative fasting instructions should be designed to minimize disruption of the normal feeding routine of the patient. The author prefers the patient eat a full breakfast between 5:00 and 6:00 AM with the usual insulin dose administered after breakfast. Arrival at the hospital should be between 7:00 and 8:00 AM, and the procedure scheduled after 11:00 AM (midday) or later to enable a 6 hour fast. Anesthesia induction should be by IV injection and rapid airway control must occur. The actual anesthetic protocol should be nicely balanced and include drugs that are short acting or reversible (example premedication: midazolam, opioid, +/- anticholinergic, example induction: alfaxan, propofol or etomidate) as this decreases the chance of delayed anesthetic recovery.

Upon arrival, and 30 minutes later, check the blood glucose and compare it to most recent curve. The glucose is then checked every 30 to 60 minutes as necessary for patient management. The goal is to have the blood glucose between 150 and 250 mg/dl during the anesthetic procedure. (Harvey, 2007)

If the initial blood glucose is greater than 300 mg/dl and the second is higher, Regular Crystalline Insulin (Humulin R®) should be administered IM at a dose of 0.1 to 0.2 U/kg IM into the hamstring muscle every 60 minutes as needed to reduce the blood glucose to between 150 and 250 mg/dl. The rate of blood glucose change should not exceed 75 to 100 mg/dl/hr. If it is decreasing rapidly, potassium may need to be supplemented IV. If the blood glucose falls below 100 mg/dl, treat with an IV dextrose solution as necessary. (Plumb, 2008 ) (Feldman and Nelson, 2004)

If the initial blood glucose is between 150 and 250 mg/dl and is stable in that range at subsequent checks, no intervention is necessary.

If the initial blood glucose level is between 100 and 150 mg/dl and the second has decreased, IV dextrose solutions should be administered to maintain blood glucose between 150 and 250 mg/dl.

Recommended intra-operative blood glucose levels are between 150 and 250 mg/dl. Patients outside of this blood glucose range can have atypical drug effects, especially involving the duration of effect being shortened or prolonged. The blood glucose is checked every 30 to 60 minutes intra-operatively to help maintain glycemic stability. The blood glucose should be checked at recovery and 30 to 60 minutes later, especially with slow recoveries. The regular feeding and insulin schedule should be resumed as quickly as possible post-operatively.
Recommended intra-operative blood glucose levels are between 150 and 250 mg/dl. Patients outside of this blood glucose range can have atypical drug effects, especially the duration of action being shortened or prolonged.

Complications with blood glucose or any other anesthetic event should be treated appropriately when initially recognized.

REFERENCES


SELECTION OF DRUGS FOR PREMEDICATION

The inclusion of anticholinergics in feline premedication protocols should be on an “as needed” basis only. Atropine and glycopyrrolate are used to prevent bradycardia which may be precipitated by other drugs and to decrease salivary secretions. These drugs should be avoided in patients with tachy-arrhythmias and in patients with glaucoma or keratoconjunctivitis sicca (KCS). Anticholinergics decrease tear formation and relax the iris sphincter muscle, causing mydriasis. Atropine is a small molecule that crosses the blood–brain and placental barriers. Overdose may cause seizure. Atropine’s duration of effect is approximately one hour. Glycopyrrolate is a large molecule that cannot cross the blood-brain barrier or placenta. It is less arrhythmogenic than atropine and overdose will not cause seizure. Vagal inhibition induced by glycopyrrolate lasts 2 to 3 hours and secretions may be decreased up to 7 hours.

The benzodiazepines, diazepam (Valium®) and midazolam (Versed®) are mild to moderate tranquilizers that are often used in compromised and geriatric patients. They have very little effect upon
cardiovascular function and have NO analgesic activity. Both drugs are reversible with flumazenil (Romazicon®). Diazepam is supplied in a propylene glycol base and is not water soluble, therefore uptake from IM or SQ injection is slow and unpredictable. Diazepam should be administered slowly IV because the propylene glycol can cause hemolysis, thrombophlebitis and cardiotoxicity if administered rapidly. Diazepam cannot be physically mixed with any other drugs without risk of precipitate formation and it adsorbs to plastic within a few minutes of contact. Midazolam is water soluble and can be administered SQ or IM with rapid and complete uptake.

The addition of an opioid analgesic to premedication protocols will enhance sedation, allow a decrease in induction and maintenance drugs, and contribute to, but not replace, post-operative analgesia. The greatest concern regarding the use of opioids in pre-anesthetic protocols is their propensity to cause vomiting. Maropitant (Cerenia®) obtunds opioid induced vomiting nearly 100%. Commonly used opioids include hydromorphone, oxymorphone (Numorphan®), methadone, morphine, butorphanol, and buprenorphine. Hydromorphone, oxymorphone, methadone and morphine are µ receptor agonists and are good choices for patients expected to experience moderate to severe pain or those with preexisting pain present more than 24 hours. There drugs will provide excellent analgesia, have fair to good sedative properties, and may precipitate panting. Hydromorphone and oxymorphone are very effective, cause less nausea, and have a slightly longer duration of effect compared to morphine. Methadone rarely causes vomiting and also has some NMDA receptor antagonism, providing analgesia through this pathway as well as the opioid pathway. Morphine causes histamine release when given IV; therefore, IM administration (or very slow IV administration) is preferred. Butorphanol is classified as agonist/antagonist, meaning that it will reverse some µ opioid effects. Butorphanol will reverse some of the analgesia provided by opioid agonists (hydromorphone, morphine, oxymorphone) and endogenous opioids (endorphins and enkephalins) and may actually increase pain perception in patients with chronic pain. Butorphanol can be used in patients expected to experience only mild discomfort or those with mild pain present for less than 24 hours. Buprenorphine, a partial µ agonist, has a duration of effect that is dose dependent and will provide mild to moderate analgesia. Butorphanol has better sedative properties than Buprenorphine but does not provide any meaningful analgesia.

The alpha-2 agonists dexmedetomidine (DexDomitor®) and xylazine (Rompun®) will cause hyperglycemia, diuresis, and vomiting (especially in cats) and should be used with caution in diabetic patients. Their effects can be overridden by catecholamines. They also interfere with thermoregulation. Both drugs are reversible with atipamezole (Antisedan®).
There are many potential preanesthetic protocols. In general, the combination of an opioid analgesic with a tranquilizer gives the most reliable and predictable results. The following examples are some of the author’s favorite non-proprietary drug combinations.

**PREMEDICATION COMBINATIONS**

1. Midazolam 0.1 to 0.2 mg/kg and buprenorphine 0.05 to 0.24 mg/kg IM (cats may become unruly and difficult with this combination)
2. Midazolam 0.1 to 0.2 mg/kg and methadone 0.2 to 0.5 mg/kg IM
3. Midazolam 0.1 to 0.2 mg/kg and butorphanol 0.2 to 0.6 mg/kg IM or IV
4. Midazolam 0.1 to 0.2 mg/kg and oxymorphone 0.03 to 0.05 mg/kg IM or IV

After premedication, patients should be placed in a quiet environment and be observed, but undisturbed, until maximal drug effects have occurred. Peak drug effects occur approximately 10 to 15 minutes after IM injection into the hamstring muscles. Peak drug effects may take as long as 60 to 90 minutes after SQ injection. The environmental temperature in the pre-surgical holding area should be relatively warm or an external heat source should be supplied because hypothermia is common after sedation. Patients should also be placed on towels or shredded paper to absorb vomit, urine or feces.

**INDUCTION OF GENERAL ANESTHESIA**

Induction to general anesthesia may be accomplished using injectable drugs or by the administration of inhalant anesthetic by facemask. In general, injectable inductions are preferred because they allow a more rapid loss of consciousness, less patient struggling, earlier control of the airway, and less danger of injury to the patient and staff. There are many drugs available for IV anesthetic induction. Popular drugs for IV induction include alfaxalone, propofol, a combination of midazolam and ketamine, and etomidate (Amidate®).

Alfaxalone (Alfaxan®, Jurox Pty Limited; Rutherford NSW, AU) is a newly FDA approved anesthetic induction drug approved for use in dogs and cats. It is classified as a neuroactive steroid and exerts its mechanism of action by modulating neuronal cell membrane chloride ion transport by binding to GABA<sub>A</sub> cell surface receptors. Alfaxalone is administered slow and steady to effect over about 60 seconds. After appropriate pre-medication, induction doses are between 1 and 2 mg/kg IV. Alfaxalone can be administered as intermittent boluses or a CRI for maintenance of anesthesia. Alfaxalone can depress cardiorespiratory function in a dose dependent manner. It has also been administered IM in combination with other sedatives and analgesics to successfully sedate fractious patients.

Propofol is a short acting hypnotic that is unrelated to other general anesthetic drugs. Propofol’s onset of action is within seconds and the duration of effect of a single bolus is 2 to 5 minutes. Induction is usually smooth; however muscle twitching can occur. The incidence of muscle twitching can be reduced if midazolam or diazepam are administered IV prior to propofol induction. Propofol is rapidly metabolized and has NO analgesic properties. Some adverse effects of propofol include apnea,
especially with rapid administration, hypotension, bradycardia or tachycardia, and decreased cardiac output by as much as 50%. Repeated administration may cause Heinz body production in cats. Propofol should be used with caution in patients with decreased cardiac reserve. Propofol’s cardiopulmonary effects are similar to those of thiopental (Pentothal®).

The combination of midazolam and ketamine will induce anesthesia within 30 to 60 seconds. The duration of a single bolus is approximately 2 to 5 minutes. Intubation is slightly different because laryngeal reflexes are maintained. Patients may also exhibit salivation, apnea, and muscle stiffness, especially with a 1:1 volume ratio of midazolam:ketamine. The author prefers a 2:1 volume ratio of midazolam:ketamine dosed at 0.5 to 1 ml/10 kg (diazepam 0.165 to 0.33 mg/kg and ketamine 1.65 to 3.3 mg/kg) to reduce muscle stiffness. Ketamine causes a central release of catecholamines resulting in tachycardia, increased cardiac output, and increased blood pressure. In catecholamine depleted patients, ketamine will act as a direct myocardial depressant and decrease cardiac output.

Etomidate (Amidate®) is an imidazole derivative whose mechanism of action is not fully understood. Etomidate has NO analgesic properties. Analgesia must be provided for invasive procedures. Etomidate has little to no effect upon myocardial metabolism, cardiac output, peripheral circulation, or pulmonary circulation, but it may depress ventilation slightly. Etomidate has been shown to decrease intraocular pressure in people; this may not be the case in veterinary patients. It is supplied in a propylene glycol base therefore rapid IV injection may cause hemolysis. Reduced plasma cortisol and aldosterone levels for up to six hours has been associated with etomidate administration.